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THE WILD TURKEY ON THE MISSOURI OZARK RANGE

(PRELIMINARY REPORT)

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INTRODUCTION

The wild turkey, a bird intrinsically adapted both to uplands and lowlands and to open country and forest, formerly was abundant over most of the United States from the Rocky Mountains eastward to southern New England (pl. 1, A) and furnished valuable food for the early explorers and settlers. Although the legally killed bird is still a food resource for residents of certain areas remote from human centers, its greatest economic value today lies in the fact that as a hunting resource it provides the incentive for one of our most thrilling of outdoor sports.

Bird-distribution charts of the Bureau of Biological Survey show that in the North Central States the natural range of the species at one time reached into the southern part of South Dakota, Minnesota, Wisconsin, and Michigan, where its numbers apparently fluctuated with weather conditions, including extremes of winter temperature. Today in the same region the wild

turkey has been killed off by hunters and crowded out by land development until the natural range now extends northward only far enough to include the Missouri Ozark section and a small area in southern Illinois.

The Missouri Ozark Range

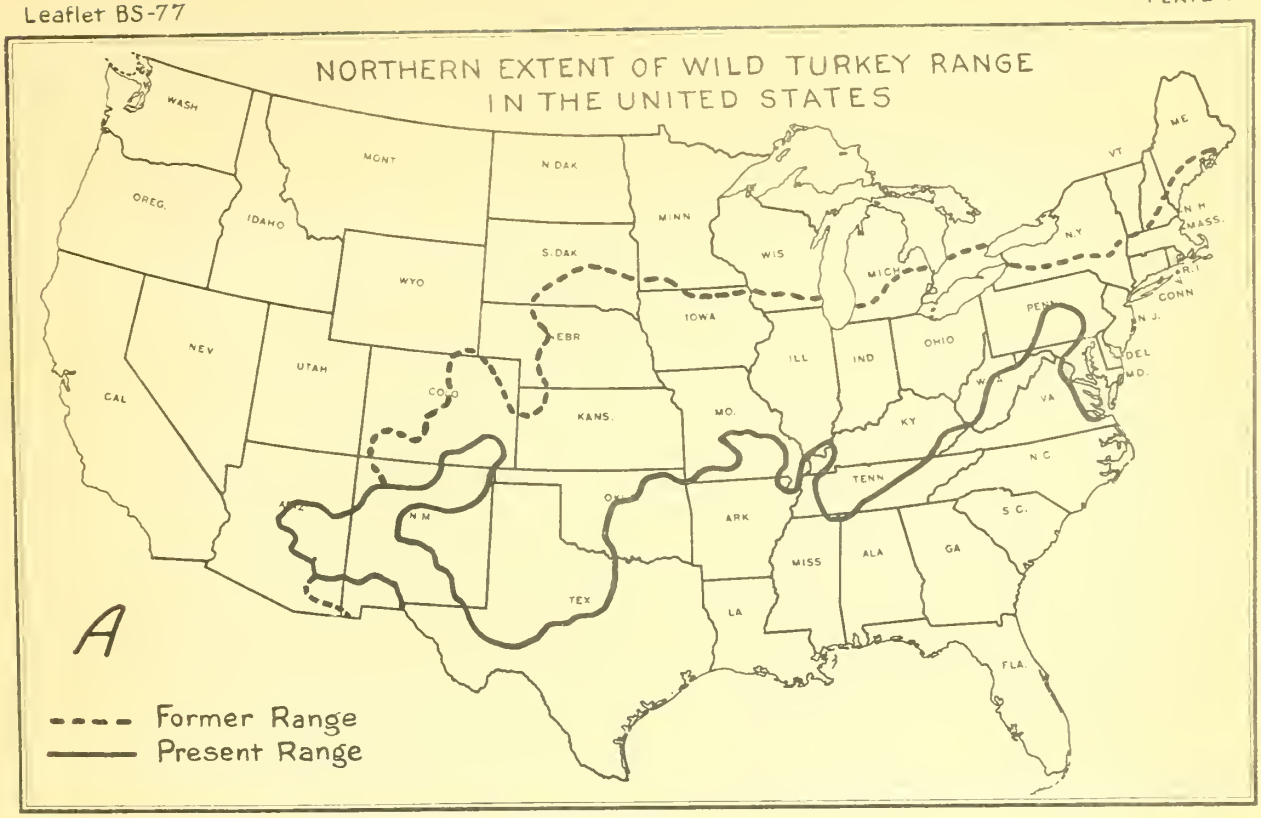
A preliminary study of range factors on the Missouri Ozarks indicates that conditions are highly desirable there for supporting a reasonable concentration of wild turkeys. The topography is ideally suited to the adaptable characteristics of the birds in feeding and in scaling-escape flight, to their requirements for gobbling and roosting grounds, and to their needs as regards properly located cover for nesting and ranging. Water, as the turkey needs and uses it, is thoroughly adequate, even in the driest season. The open and cut-over condition of the entire Ozarks affords ideal dispersion to cover and open areas, with a diversification of food supply impossible under heavily forested conditions. The annual mast crop far exceeds the possible need, choice varieties of fleshy fruits much used by turkeys are abundant, and repeated firing of the range has assisted in developing an exceedingly rich leguminous flora.

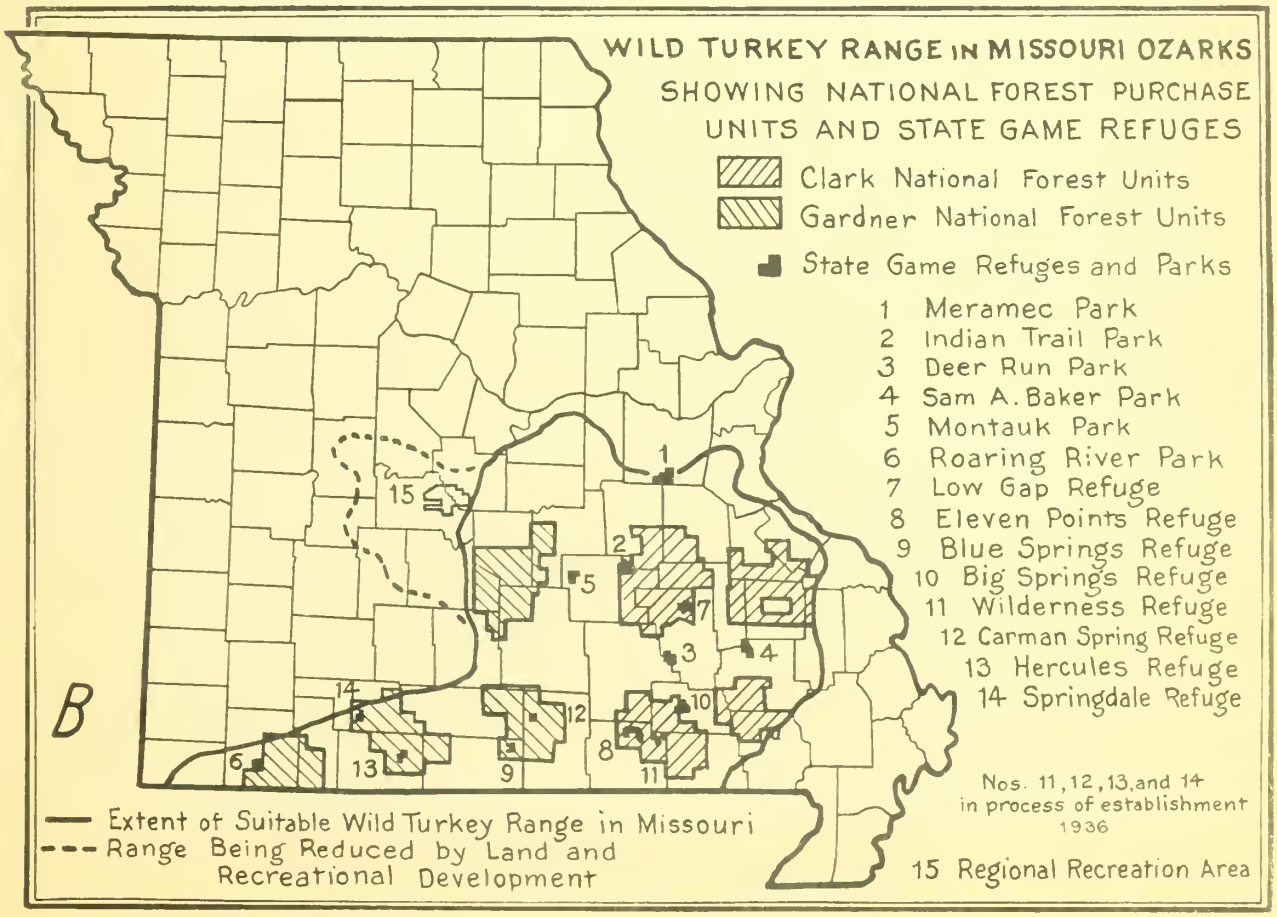
Types of Turkey Involved

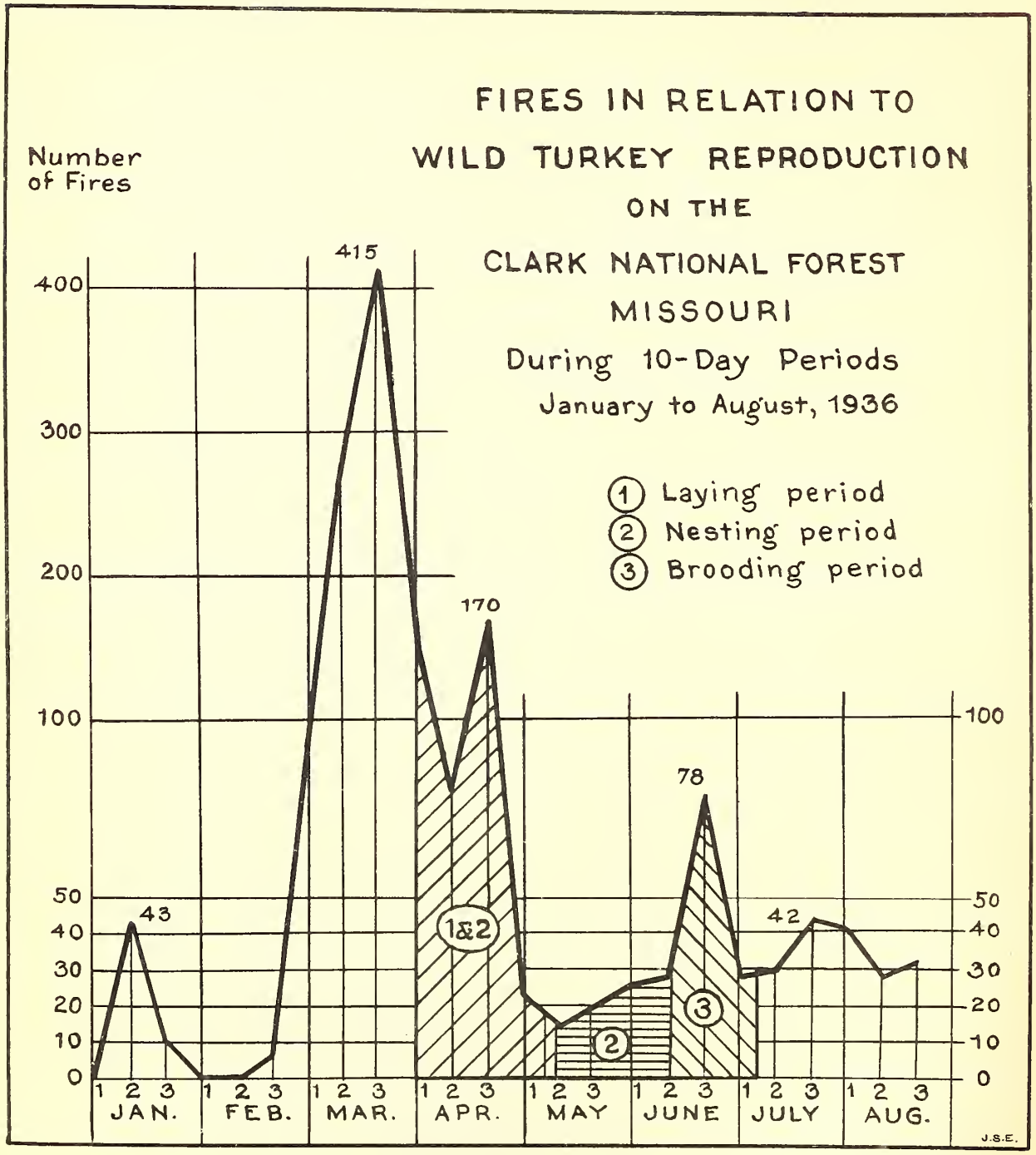
Native and artificially propagated stock.--Recent extensive restocking liberations by the Missouri Game and Fish Department have suggested the possibility that the remnant of wild stock in the Ozarks is an intermixture of birds of the native wild strain and of the artificially propagated strain. Domestic-stock turkeys, raised on farms in the wild turkey range, also probably have gone wild and interbred to some degree. Field observations and other considerations, however, tend to discount the probability of much contamination. The artificially produced brood stock has been liberated in good turkey range, but not in the remote areas now used by the largest concentrations of native wild turkeys. Liberations thus far have been confined chiefly to game refuges within State parks. To protect free-range liberations, those outside of State parks have been placed on managed areas of private land where the possibility of contact with the native wild bird is restricted or completely removed.

Characteristics of the wild turkey.--Field study and the collection of specimens of native wild turkeys indicate that splendid specimens of the so-called "moss head," "blue head," "swamp," "little black", and "hill" wild turkeys of the northeastern subspecies (Meleagris gallopavo silvestris) still exist in numbers that will surprise the casual observer on the Missouri Ozark range. Unquestionably, the most desirable management is that applied to the native wild bird on its natural range. This raises two questions: (1) What makes the turkey wild? and (2) What characteristics are to be set up as a standard for the quality wild specimen artificially propagated or produced naturally in the wild?

Wildness has been demonstrated as resulting partly from parental education and partly from reaction experience obtained from environment and from flocking with other wild turkeys. Newly hatched poults, both of wild and of


NORTHERN EXTENT OF WILD TURKEY RANGE
IN THE UNITED STATES
WASH
OREG.
CAL
NEV
IDAHO
MONT
WYO
UTAH
ARIZ
N.MEX
COLO
N.DAK
S.DAK
NEBR
KANS.
OKLA
TEX
MINN
IOWA
MO.
ARK
LA
WIS
ILL
MICH
IND
OHIO
KY
TENN
MISS
ALA
GA
FLA
S.C.
N.C.
VA
W.VA
PENN
N.Y.
ME
VT
N.H.
MASS.
R.I.
CONN
N.J.
DEL
MD.
A
Former Range
Present Range


WILD TURKEY RANGE IN MISSOURI OZARKS
SHOWING NATIONAL FOREST PURCHASE
UNITS AND STATE GAME REFUGES
Clark National Forest Units
Gardner National Forest Units
State Game Refuges and Parks
1 Meramec Park
2 Indian Trail Park
3 Deer Run Park
4 Sam A. Baker Park
5 Montauk Park
6 Roaring River Park
7 Low Gap Refuge
8 Eleven Points Refuge
9 Blue Springs Refuge
10 Big Springs Refuge
11 Wilderness Refuge
12 Carman Spring Refuge
13 Hercules Refuge
14 Springdale Refuge
Nos. 11, 12, 13, and 14
in process of establishment
1936
15 Regional Recreation Area
B
Extent of Suitable Wild Turkey Range in Missouri
Range Being Reduced by Land and
Recreational Development


FIRES IN RELATION TO
WILD TURKEY REPRODUCTION
ON THE
CLARK NATIONAL FOREST
MISSOURI
During 10-Day Periods
January to August, 1936
Number of Fires
1 Laying period
2 Nesting period
3 Brooding period
400
300
200
100
50
40
30
20
10
0
415
170
78
43
42
1&2
1 2 3 JAN.
1 2 3 FEB.
1 2 3 MAR.
1 2 3 APR.
1 2 3 MAY
1 2 3 JUNE
1 2 3 JULY
1 2 3 AUG.
J.S.E.

confined wild types, show similar reactions, so parental training may be the basic difference between native and planted stock. Experiments, however, show that these wild traits may to a certain degree be acquired later in life. A young gobbler forms a large part of his wild habits during his second year under the leadership of an older gobbler.

Three desirable characteristics of a wild turkey may be mentioned: (1) A reaction to environment that perpetuates the race in the wild in good physical condition; (2) a reaction to man and beast that makes a desirable hunting resource; and (3) a conformity to the physical qualities of the traditional trophy type.

These desirable physical characteristics of the wild turkey include light build, fusiform body, and upright carriage; slender pink legs and small neck and head, the latter definitely flat; a minimum-sized wattle in both male and female; barred rump and tail feathers with dark brown tips, evenly barred black-and-white primaries with mottled black-and-white secondaries; and definitely square-tipped body feathers with a pronounced bronze effect, reflecting more of the red rays in their metallic illumination.

Although some excellent birds are being propagated, breeders are still confronted with the problem of producing a pure strain of the trophy-type specimen comparable with the bird in the wild.

Conservation Efforts

Beginnings in Missouri.--Ten years ago it became apparent on the Ozark range in Missouri that without proper management, the wild turkey, like the ruffed grouse and upland plover, would soon be reduced to a point approaching extinction. As with other species, practical measures of restocking (based on trial-and-error methods) preceded the fundamental research and the study of management practices that are vital to an effective restoration program. Constructive interest about 1925 crystallized into the Missouri Game and Fish Department's program of restocking with artificially propagated birds. The original plan of liberating birds of a domestic strain was soon abandoned in favor of producing a quality bird--one approximating as closely as possible the characteristics and qualities of the native wild turkey--and the present program features mass production and liberation of turkeys of such quality. The liberation of many thousands of these birds has achieved slight success, however, because of lack of adequate protection and of suitable conditions for accommodating them to natural wild living. The multiple problems encountered made obvious the urgent need for basic research.

Cooperative undertakings.--The National Forest Purchase Program in Missouri, initiated in 1933, opened a new avenue for constructive wildlife restoration in the utilization for cooperative efforts in wild turkey management by the State Game and Fish Department and the Federal Forest Service of some 3,319,939 acres, all within the heart of the Ozark turkey range (pl. 1, B). These facilities for intensive management again emphasized the necessity of scientific direction of administrative plans and brought about

the present research program being conducted by the Biological Survey in the life history and management of the wild turkey in Missouri.

Success of restocking liberations.--Evident survival from early liberations would not indicate the probability of much interbreeding. Early mortality has been exceedingly high. Sometimes complete extermination resulted in the amazingly short period of 48 hours and, in most cases, within 12 months. Some few birds have gone wild, but the majority that survived these early restoration attempts have become useless as wild stock either by frequenting local farm yards during the first winter season or by falling further victims of gun or club at a later date. The opportunity for interbreeding, therefore, is questionable. Recent liberations under managed conditions show better survival, but lack of protection against both legal and illegal killers frustrates management when birds range beyond the limits of protected areas.

Research undertaken by the Biological Survey.--In January 1936 the Biological Survey, cooperating with State officials and the Forest Service, established a research station in Missouri, with headquarters at St. Louis. The Forest Service furnishes office accommodations, field transportation, and field facilities for demonstration and research projects. The State Game and Fish Department furnishes field-demonstration areas under State supervision and wild stock for experimental turkey management. The first year's investigation by the Biological Survey has involved careful study of the conditions (favorable and unfavorable) affecting the population and distribution of the birds, seasonal range use and movements, reproduction, survival, sources of loss, food habits, and the effects of fire and domestic stock on turkeys and on their range.

With native wild-bird management as the objective, a clear idea of the native stock available was recognized as essential. No satisfactory method of taking a wild turkey census has been worked out, but continued field observation has readily determined the number using a township or more of range. Intensive checking showed 12 native wild turkeys on one township of used range at the beginning of the 1936 breeding season, or approximately one bird to three sections in part of the best native wild turkey range on the southeastern Missouri uplift.

Over the southeastern Missouri range as a whole the average density per township would be greatly reduced, however, because during most of the year no birds are found in some townships. The scarcity of brood stock at the outset of the breeding season throughout this part of the range does not warrant an annual hunting season as long as that now provided (30 days).

In a more heavily populated southwestern Missouri area, Taney County, approximately 100 birds were killed during the open season in December 1935 in the southern half of that county, which equals the kill on similar areas in the more heavily populated turkey ranges of Virginia and Pennsylvania.

This figure, however, is local and can not serve as a basis for an Ozark-range estimate. The present research program eventually will develop the complete picture.

The pages that follow constitute a preliminary report on the research work of the Survey and treat of the life history of the wild turkey, factors that limit its abundance, and some essentials of field-management practices.

LIFE HISTORY

Nesting

Dates; habits of birds at outset of season.--The first evidence of the wild turkey's nesting season is a shifting of daily range beyond the regular limits of the wintering grounds and a change in flocking habits. Abundant succulent green herbage appears between March 15 and 25. This may have something to do with water requirements of birds on the range as an accompanying change in water use is noted. Water holes, frequented daily (or at least regularly) over a three-day period prior to this change, are abandoned or visited only occasionally.

The range of the birds apparently shifts from dense brush cover of protected uplands to more open hilly country. This shift covered a distance of three or four miles, when freedom from fires, predation, and poaching, or other factors of an abnormal movement prevailed.

The large mixed flocks common to the winter range begin to split up into small groups of four or five birds. One or two gobblers usually accompany each group of hens--in many instances, an old gobbler and a young one of the previous season. No segregation of hens by ages is noted, but gobblers of the first year frequently flock to themselves on a regular range, over which they have been observed to travel two or three miles daily. Later, when older gobblers take up with bands of hens and establish family groups for the nesting period, young gobblers may join the groups, but apparently do not enter into the breeding reaction.

Selection of nesting sites.--It has been observed that each hen withdraws from the group to locate her nest. The action noted may have been influenced by the abundance of cover and the relatively small stock of breeding hens on the range; also the observation does not preclude the possibility that, under different conditions, more than one hen might lay in the same nest or that two or more may render mutual assistance in incubating the eggs.

With artificially propagated wild stock on limited range, two or more hens are frequently found laying in the same nest. Under such conditions a wandering hen may lay regularly in various borrowed nests without contributing to the hatching duties. It is not uncommon to find two hens sitting on one nest throughout the period. Audubon, observing the native wild turkeys in the South (1840-44), reported three hens sitting on 42 eggs and asserted that they might continue throughout the laying, hatching, and brooding seasons with one hen always on guard.

Typical nesting ground.--The turkey hen is very versatile and may place her nest in any one of many environments. No definitely preferred exposure is indicated, but observations show a preference for ready visibility overhead and in two or more directions, an open avenue of escape flight, and an aversion to flat surfaces approachable from all sides. Nests invariably are located in exposed places, the hen relying upon her protective coloration and keen sense of sight and hearing to outwit wandering predators. The sides of logs, heavier limbs of treefalls, and jutting limestone shelf rock offer choice nesting sites.

Some nests are found in perilous places. One was observed on the nearly perpendicular slope of a sink hole some 30 feet deep, and the scant space that accommodated the nest could be approached only by flying. Quick escape was possible through the opposite side of the sink hole, which had been washed away into a lower drainage, where the hen, pitching off the nest, could scale for several hundred yards. No difficulty in bringing the brood off this nest was observed. Another nest was found within 6 inches of the edge of a sheer 100-foot cliff. Most losses from such nests are probably caused by eggs rolling out, as newly hatched poults show an instinctive tendency to scramble desperately upgrade when disturbed or when ranging from the nest.

A few nests of restocked birds have been observed on low ground protected by dense high weeds where the visibility was low. These are not considered typical. In such situations, some nests of eggs have been lost during extremely high waters following cloudbursts, a characteristic of the Ozark spring season.

Nesting range relationship to water.--Turkey nests are seldom far from water. Hollowhead and ridge-top country (typical turkey nesting range) seldom has much permanent water at this season, but sufficient sources are always available. The laying and nesting hen under observation goes to water daily at a regular time and at a regular place until the last few days of the incubation period. When the eggs begin to pip, she apparently goes without water until able to lead her brood from the nest.

It is unlikely that water shortage is ever a serious limiting factor to turkey nesting in the Ozarks, as water is available on, or immediately adjacent to, any nesting site on the forest at that season. Although the water requirements of the wild turkey may be supplied by dew and succulent green food during certain periods, the xerophytic condition of the Missouri Ozark range throughout the summer months indicates the importance of surface water to turkeys' use of the range.

The 1936 laying-hatching period in the Ozarks was typical of the driest years ever recorded there. Small ridge-top mudholes and hog wallows, used by turkeys as water sources, completely dried up, but larger permanent sources were sufficiently numerous for all needs.

Description of typical turkey nest.--A wild turkey nest is hardly worthy of the name, as commonly applied. By wallowing on the ground, the hen creates a slight depression, just sufficient to hold the eggs together and in direct contact with the damp earth. Sitting down, she pulls dead leaves up around the nest by inward brushing strokes of head and neck. Much of her time on the nest is spent rebuilding the edge of the nest with this head movement. A nest may in time become so flat from the manipulation of a large number of eggs that some of them may be easily rolled out.

A wild turkey hen has been observed carefully covering her eggs with leaves before going away, a concealment effort thought to be a regular habit. Other nests observed with the eggs exposed may have been left exposed because of an irregularity in this habit or of some sudden disturbance.

Egg laying

Beginning dates and average extent.--The average wild turkey laying season in southern Missouri apparently extends from April 1 to May 15. The hatching of one nest of 16 eggs on May 12 would indicate that laying began during the last days of March, to allow for the known period intervening between laying and hatching. Other observations record one turkey laying as late as the second week of June. There are as yet no records to show what percentage of such late nestings may represent second nestings caused by a previous failure.

It is thought that a normal turkey hen of any age will begin laying not later than the first of May. The peak of the laying season may be placed in the last two weeks of April, and that of incubation during the last two weeks of May.

One specimen of laying hen was collected for study on May 27. The ovaries showed a retarded (or limited) development, different from the pronounced gradient series of eggs in process of formation to be found in the normal hen in the midlaying season. Otherwise the individual apparently was a splendid specimen in good physical condition. This condition probably is characteristic of the hen that has produced a large number of eggs because of an earlier nesting failure.

The laying cycle.--The laying process begins irregularly, the hen often skipping a day. Study of the artificially propagated wild turkey shows that, when this function becomes regular, one egg is laid daily, approximately one hour later each day, beginning at about one hour after sunrise and continuing until sundown terminates the cycle. Then the hen may skip a day and begin over again at the early morning hour and repeat the cycle.

In birds under controlled conditions, all forms of irregularity in this cycle may appear, such as laying on the roost, due to delayed laying at the end of the day; laying two eggs in one day during the peak of the season; and greatly delayed laying, caused by irregularities in physical condition.

Habits of hens during laying period.--One service by the gobbler has been demonstrated as sufficient to fertilize an entire clutch of eggs, but mating normally continues throughout the laying season. When breeding birds are kept confined, the hens should be isolated three weeks to eliminate undesirable fertilization.

The wild turkey hen, after depositing an egg and usually concealing the nest with leaves, departs and runs with the family group during the day. No observations have been made to demonstrate that the laying hen makes any effort to protect her nest against predators during this period. There is little scent at this time, however, to attract predators, and the site chosen is usually such as to minimize the possibility of accidental discovery by marauders.

Incubation

Duration and irregularities at outset.--The turkey egg requires 28 days to hatch, varying only a few hours either way. The incubation period begins irregularly. After laying an egg late in the afternoon, the hen may sit until nightfall, then leave and roost as usual. This action may continue a second day before she stays on the nest all night. Another hen may stay the first night, but leave the second. The third day generally begins regularity of incubation, interrupted only by regular periods for feeding and watering.

The hen is not assisted by the gobbler in the incubation process. An amusing observation, however, was made on one of the restocking-management areas. An exposed and unattended nestful of eggs was found by an old gobbler. He eyed the eggs with intense interest, readjusted them with his bill as if purposely turning them, then carefully settled down upon the nest. Ruffling out his feathers, he started picking around the nest, drawing up fresh leaves much as a hen would do. But his patience was short, and after only a few minutes he leisurely arose and sauntered off as though his full duty had been performed.

Habits of hens during incubation.--The sitting hen soon develops regular daily habits, leaving the nest at regular intervals for specific purposes. Between 30 minutes before sun-up and 30 minutes after, the gobbler gives forth his rumbling call from his roost or from his favorite gobbling point near his family group. Early in the nesting period, the hen leaves about the same time, or in answer to the call, spends a few minutes in the gobbler's company (albeit paying little, if any, attention to him), feeds in his vicinity awhile, then returns to her nest. No mating has been observed after incubation begins.

These morning visits grow less frequent as the incubation period progresses. Finally the hen remains on her nest, leaving for water on a regular daily schedule. Usually within an hour of noon, she may be observed approaching the water source at the same spot every day. Near the end of the incubation period these trips become irregular until the last two or more days, when she does not leave the nest.

Sitting hen's reaction to intrusion.--During the approach of a man; so long as the wild turkey hen feels unsighted, she will remain motionless on her nest, crouching close to the ground and relying for concealment upon her protective coloration. A native wild hen permitted an observer to pass within 50 feet of her when he was moving at a leisurely gait and not focusing attention upon the nest. The least hesitancy by the observer, however, or the least sign that the nest has been spotted, will cause the hen to burst from the nest, sometimes pretending she is crippled by dragging a leg, a wing, or both, several yards before taking off in full flight away from harm.

"Cripple" deception.--A similar "cripple"-deception demonstration was observed when a laying hen was encountered in the field at a considerable distance from her nest. On an old ridge-top trail some 100 yards or more from her nest, the hen suddenly appeared from roadside cover and flapped desperately in her efforts to travel down-trail ahead of the observer, who continued at a slow gait. The hen "recovered" slightly for a time to get a safe distance away, then repeated her cripple act. Upon reaching a steep point 100 yards down the trail, she cast off deception, took a few bold upright strides and a final leap, burst upward at a sharp angle to clear the cover, and sailed away half a mile in straight line to the opposite side of the valley.

The Egg

The clutch.--An exceptionally wide range of characteristics is found in wild turkey eggs. Varying numbers laid by individual hens lend wide range to the size of a clutch. First-season birds are accredited with laying normally small clutches, there being an increase in size of clutches with maturity of the bird. The age of maturity for the native wild hen was established in 1932 by Wilson at four years. Average clutches in the wild range from 9 to 15 eggs each, with 15 most frequent. Extremes for one hen are 6 and 32 in a single clutch. Bent (1932) established the size of the clutch as follows: "The normal set for the wild turkey numbers 8 to 15. The smaller sets are laid by young birds. As many as 18 or 20 eggs have been laid in a nest, which were probably laid by one bird." Artificially propagated wild turkey hens on open free range show an increase in average clutch size, the number ranging from 14 to 18 eggs, with extremes of 10 and 22.

Characteristics and measurements.--Despite wide variance in wild turkey eggs, those laid by any one hen are relatively uniform, and where several hens lay in the same nest those laid by each can usually be distinguished by similarity in shape, weight, color, and shell texture. Young hens and very old hens generally lay small eggs. Eggs produced at the beginning and ending of a laying period may be smaller than usual. Small hens and those with compressed pubic processes frequently lay long slender and very pointed eggs, light in weight.

Measurements and weights of 500 eggs, produced by choice artificially propagated wild turkey hens and selected at random as pen-run eggs, showed an average length of 59.74 mm. and width of 45.69 mm., with a weight of 2.37 ounces, or 69.19 grams. These birds were in semiconfinement and on artificial feed. The same measurements made on 50 native wild turkey eggs, produced by wild birds on free open range and obtaining natural foods, showed no appreciable difference either in size or in weight. Their average length was 58.2 mm., width 46.1 mm., and weight 2.28 ounces, or 66.55 grams. The weights of both groups were taken within one to seven days after laying and under average cool temperatures. Bent (1932) records the measurements of 56 wild turkey eggs with an average length of 62.6 mm. and width of 44.6 mm.

By eliminating the small, slender and light eggs from classification, as being products of just average normal hens, the average measurements and weights of the choice wild turkey egg obviously would tend to be slightly increased.

The select wild turkey egg.--The select wild turkey egg is bluntly ovate but definitely smaller at one end than at the other. It is irregularly marked with fine blotchy spots or specks of dark brown. The porous shell is of a coarse granular texture and is evenly covered with a clear colorless protective membrane.

Variations and their significance.--Innumerable variations from the typical egg standard may be found. Some eggs are chalky white, some without, or only partially covered by, the protective membrane. Others are coarsely marked with large brown spots on a rough shell. Some are extremely pointed at one end, others show no difference between the ends or are nearly round. Sometimes the eggs are soft-shelled or double-yolked. The percentage of such eggs is small, however, and they are relatively unimportant in their effect on the sum total of turkey welfare.

Surprisingly enough, strong healthy poults frequently hatch from eggs that have external characteristics that would appear to be disadvantageous.

Hatching

Length and characteristics of hatching season.--The actual hatching period, from the time the first poult appears until the hen leads her brood from the nest, appears to cover 24 to 36 hours, with hatching in progress over the entire period. Variable duration of the laying period, with accompanying changes in temperature and weather conditions, tends to produce different stages of development in various eggs. Four eggs removed from a nest during the first week of June, and held in a laboratory for experimental purposes, hatched in normal manner at the proper time by mere exposure to atmospheric conditions in extremely hot weather.

Egg loss and mortality.--Egg loss and mortality in the wild are probably less than under conditions of restocking, as a concentration of nests increases the attraction for predators. Of 997 eggs incubated by restocked wild turkey hens, 874 (87.6 percent) hatched, with a loss from all causes of 123 (12.3 percent) of all eggs set. Of the 123 eggs lost, 38 (3.8 percent of the total) were infertile; 11(1.1 percent) failed to get out of the shell, and 74 (7.3 percent) were lost to known predators and unknown sources that destroyed or removed whole clutches or nests.

Brood's first trip from nest.--While hatching poults demonstrate different degrees of vigor in freeing themselves from the shell, pipping among restocked birds usually occurs during a 12- to 18-hour period under normal ground-nesting conditions. Early in the morning, following an average of one day and two nights continuously on the nest, the mother hen becomes restless as early-hatched poults start wandering around the nest. Weather permitting, she leads her brood slowly off on their first reconnaissance trip. If the ground cover is too wet at this time the poults will suffer from exposure.

Brooding

The newly hatched wild turkey brood's first venture into Nature's wonders is leisurely taken, the mother hen keeping her young as close as possible to low protective cover. The trip begins only after the morning sun has reduced the danger of the young birds' becoming chilled by exposure to the dew.

Weather perils to poults.--Losses during the first ten days may be considerable in bad weather, as poults, even up to two weeks of age, cannot stand wetting or chilling. One restocked hen was observed, after a short average spring shower, brooding nine poults one week old, all dead. Several poults of a large flock, unable to get completely under the protective covering of the mother hen, may drown from only a few minutes partial exposure to the direct force of a shower. The hen does everything to shelter the brood, seeking the best overhead protection available and swelling out her feathers to provide the largest possible coverage. She does not settle down upon the poults but stands in a crouched position, under which shelter the feet of the young birds may be seen at a distance.

Favored type of range.--Borders of open fields, providing low cover leading into heavier timber, are favorite ranging areas for young broods. Later, they range farther into open spaces to seek the larger supply of insects to be found among the weeds and grass.

Food Habits

A complete study of the food preferences and requirements of the wild turkey in the Missouri Ozarks has not been possible because of the scarcity of the birds. It is impractical to kill large numbers for analysis of the content of crop and gizzard, and only a few specimens have been supplied for such studies by hunters during the regular hunting season in December. To supplement the limited stomach material available and thus af-

ford some basis for conclusions as to preferred foods, extensive observations have been made of the feeding activity of restocked birds on the Ozark range.

The food requirements of native wild birds cannot be determined satisfactorily, of course, in the field, because the birds will not permit close observation. Studies of restocked birds, however, after their adjustment to natural feeding on open range, give reliable information as to the kind of plant foods they most frequently use.

Determination of food preferences by field observation was accomplished by following feeding birds as closely as possible to witness their eating of plants or parts of plants; collecting the individual plants observed to be eaten; carefully verifying what part of the plant specimen had been consumed; and finally, identifying the plant.1/

All the information on food habits obtained both from field studies and from laboratory analysis of stomach contents has been summarized and that on plant food is presented at the end of this leaflet as table 1. The ratings given the various species as to food importance, indicated in the table by one or two asterisks, can be considered only tentative. They are subject to revision as more complete data are obtained.

Animal food items were identified by stomach analyses, the material examined being that supplied by hunters during the December open season. Following is the animal food identified for that month, all but the first item (spiders) consisting of insects:

Spiders (Araneida), walking stick, or devil's darning needle (Diapheromera femorata), red-legged and other grasshoppers (Melanoplus femur-rubrum and Melanoplus sp.), stink bug (Pentatomidae), caddisfly (Phryganeidae), robber fly (Asilidae), ground beetle (Carabidae), blister beetle (Meloidae), weevil (Balanus sp.), ichneumonfly (Amblytelinae), and ants (Formicinae).

Habits and training of poults in feeding and flocking.--The brood seems to feed continuously, except for casual resting spells in the shade of tall grass and other low cover, which become more frequent during midday heat. Young birds are natural-born explorers, pecking at small leaves of green plants, scratching in soft ground litter, picking up weed seeds, trying to swallow or strip the seed heads of grasses, or wildly chasing small insects.

The mother hen immediately starts teaching her brood to hunt and eat insects. She will catch small insects in her beak, or tear apart large ones, then call her brood with sharp clucks that bring them running from all directions. The poults soon learn to chase grasshoppers and ground

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1/ In addition to acknowledging assistance rendered by the Food Habits Laboratory of the Biological Survey, the writer is indebted to Julian A. Steyermark, assistant conservationist of the Forest Service, for cooperation and assistance both in field observations and in identification of plant material and to botanists of the Bureau of Plant Industry for suggestions with regard to nomenclature.

beetles (probably excited by their sudden motions) until they become lost in the ground cover. Their loud distress calls are constantly being answered by the hen's collecting call to guide them back to the flock.

Dusting.--The common practice of dusting seems to be the newly hatched poults' only method of bathing and combating ticks, chiggers, fleas, and lice. Older birds are usually found dusting in decayed litter, especially decayed wood and ant mounds, but the poults use any dry ground in open spaces on their feeding range. Two separate broods in one large field were observed dusting in the heat of midday, alternately stretched full length and motionless in the blazing sun, then beating their wings and scratching with their feet to raise dense clouds of dust.

Water resources and their use.--Water is vital to the growing poult. Older birds may go short periods without water, but only under stress of circumstances, such as attention to a hatching clutch of eggs. The poults' water needs can be supplied by dew on the ground cover during early morning, by succulent green feed, or by small reservoirs scattered over the range, such as in cattle and wagon tracks.

Water resources are limited on the Ozark range during the early brooding season as dews are absent over a protracted period and the early-summer sun dries up ridge-top depressions, hog wallows, wagon ruts, and stock tracks, which are favorite watering places. The mother hen, however, manages to find a range close enough to permanent water for daily visits. This may require a shift in range early in the brooding season. One brood was observed to water twice daily during extremely hot weather when forage was exceptionally dry. This brood established a range extending less than a quarter of a mile from their source of open water during their first two weeks of life.

FACTORS LIMITING ABUNDANCE

Predators on Eggs

Snakes.--Outstanding among predators on turkey eggs is the black snake, which has been known to swallow nine wild turkey eggs one after another. These nine eggs were removed from the snake and hatched normally under artificial conditions. This snake will take one or more eggs and return later for others until a whole clutch may be destroyed. It swallows the egg whole, dissolving the shell slowly.

The Ozark timber rattlesnake also is fond of wild turkey eggs, one being observed immediately after it had swallowed four. Black snakes and rattlers are common on the Ozark nesting range and probably take a heavy toll of eggs. Of the two, the black snake is the more destructive because of its greater numbers and larger capacity. Of the numerous copperhead snakes in this region, only one individual has been observed swallowing an egg.

Opossums.--No restocked area under management is ever free of the opossum as an egg poacher. This mammal has been observed to take an egg 50 feet to 150 yards from the nest before breaking a hole in one end and

sucking it dry. It then leaves the shell in some beaten path over which it departs. When so removing eggs from the nest, the opossum will take one or more eggs at each visit, but invariably returns for more later.

Relative sizes of the turkey egg and the opossum's mouth have caused much conjecture about this predator's method of carrying an egg away from the nest. Late one afternoon, an opossum was observed leisurely carrying one down a steep slope in the crook of its tail. Sighting the observer, it released the egg and played dead, as is its habit. Whether this observation discloses a natural habit of the animal in carrying eggs is questionable.

Ground hogs.--Fresh ground hog tracks and other signs have been found in and around turkey nests soon after they were torn up and some eggs eaten. If further study confirms this rodent as a turkey-egg predator, it may reveal a source of heavy loss, because of its abundance and wide distribution over the turkey range.

Foxes, stray dogs, and hogs.--Abundant signs around several nests on restocked areas indicate the fox to be a killer of birds on the nest, but whether Reynard takes eggs, with the hen either present or absent, has not been disclosed by the investigations thus far made.

Stray dogs in the woods have destroyed both nests and eggs in restocked areas under management.

Some nests indicate destruction by free-range hogs, but the extent is problematic because wild turkey nests are fairly well hidden from the more open areas where hogs are wont to forage. It is well known that turkey nests are quickly destroyed after abandonment, and tracks and uprooted earth indicate the work of the hog.

Crows.--The crow is abundant and widely distributed, and early investigators report that these marauders will flock around and watch turkey hens until they return to their nests, thus disclosing the location of their eggs. Crows in the Ozarks have been observed following groups of turkey hens with great persistence, but no actual evidence of egg depredations has been noted.

Other Causes of Egg Losses

Burning off the woods.--One major nesting hazard and an evident source of serious egg loss is the habitual burning of the Ozark woods. One native wild turkey nest was discovered this year with 16 eggs completely burned, about ten days (estimated) before they would have hatched. Extensive known turkey ranges and nesting areas have been burned bare, destroying every sprig of ground cover that might harbor a turkey nest. The extent and effect of this is later discussed under the section on Field Management.

Flood waters.--On restocked areas some nests built in drainages have been washed away by high waters. Under strictly natural conditions, however, such losses are considered insignificant, if existent at all, because the native wild hen is more cautious and secretive in her nesting habits than the artificially produced bird even during her first year of liberation, and much more so than later on if management is intensive.

Infertility and Hatching Weakness.--The natural factors of infertility and hatching weakness are less evident than the losses from predators and mechanical causes. Losses from egg weakness and failure of poults to get out of the shell are relatively high in artificially produced and artificially hatched eggs. Eggs collected in the wild and artificially hatched seem to lack this hatching weakness, pointing to the production of more vigorous poults by the native wild bird. Only one instance of native wild turkey eggs failing to hatch through infertility and hatching weakness has been observed.

The previously mentioned 12 percent loss of eggs from all causes, including predators, when added to the unknown but apparently high loss by fire, makes a seriously large total.

No losses have been recorded from nest parasites. Some loss in hatching is caused by poults being mashed by a mother hen covering a large clutch of eggs.

Predators on the Birds

Bobcats and wolves.--Rougher parts of river drainages in the Ozark turkey range support numerous bobcats, which probably figure in turkey depredations, especially as regards the poults. The keeper of an area restocked for management observed a bobcat making off with a three-fourths grown turkey. Destruction of one nest on a similar area, where the hen was killed on the nest, was accompanied by definite wolf sign.

Owls.--Both short-eared and long-eared owls have been known to kill poults eight weeks old on the roost at night. These small owls knock the poults from the roost and attack them on the ground, neatly snapping off their heads. One short-eared owl was caught in the act in a management pen after it had killed six poults. The owl consumed only the breast portion of one poult, leaving the other birds as evidence of an outright killer instinct.

The great horned owl has been known to attack grown wild turkeys on the roost, killing in the same manner as the smaller owls. This larger owl will return to feed on the carcass of an individual kill. One turkey hen from liberated brood stock on free range was observed under attack by a great horned owl on the ground in broad daylight. The hen partly succeeded in avoiding the downward strikes of the owl and finally escaped into nearby cover with deep lacerations on the back, inflicted by the owl's talons.

Opossums.--The opossum has been caught red-handed taking restocked birds from a roost. The animal carefully approaches the roost, seizes a bird about the neck and body in a death grapple, and clings on until its victim is dead and falls from the roost. The opossum, like the large owl, will return until it has devoured all edible portions of its kill.

Wild turkeys make valiant efforts to protect their young against night predators. One hen, with 14 poults hatched and raised on free range, kept losing one or two until only four remained. Later this hen was observed on a carefully selected roost in a pine tree, hovering the four poults (then eight weeks old), two on each side of her, her wings outspread to their complete extent to cover the four. Apparently she succeeded in bringing all of

these through the brooding season. The other ten were known to have been lost from the roost at night, the specific causes undetermined.

Diseases

Native wild birds.--No indication of infectious diseases among wild turkeys has thus far been observed in this investigation, and little information is available to suggest the occurrence of disease outbreaks or periodic fluctuations in populations from such causes.

Two observations made independently about 1921-22 on the Ozark turkey range show a possible occurrence of some abnormal physical condition. Wild turkeys were reported on open range that were evidently "sick", being emaciated and weak, apparently taking no food or water, making no attempt to escape from hunters, and evidencing unstable equilibrium. These symptoms are typical of several diseases affecting turkeys in general, and do not seem attributable to any one physiological cause. Other persons reported finding dead wild turkeys in the woods during the same season, which would indicate the possibility of some epizootic occurrence throughout the range.

Artificially propagated wild turkeys.--The artificially propagated wild turkey, raised and held in captivity, is subject to an extended group of infectious avian diseases, parasitic infestations, and other pathological conditions, including the following:

Bacterial and filtrable-virus diseases:

- Roup, or fowl diphtheria, in various forms and combinations of pathological conditions, including:
  - Diphtheritic lesions of the mouth.
  - Pox lesions of the skin.
  - Tracheitis.
  - Edematous roup, or swelling of the sinuses.
- Fowl typhoid.
- Cholera.
- Tuberculosis.
- Intestinal inflammation (enteritis).
- Botulism.

Protozoan diseases:

- Blackhead (enterohepatitis).
- Trichomoniasis.
- Coccidiosis.

Fungous diseases:

- Aspergillosis.

Parasitic infestations:

External:

Ticks.
Chiggers.
Fleas.
Lice.

Internal:

Roundworms (nematodes).
Tapeworms (cestodes).
Flukes (trematodes).

Other pathological conditions:

Pendulous crop.
Impacted crop.
Intestinal obstruction.
Nutritional deficiency.
Breeding and hatching weakness.

Human Activities

Non-cooperative native squatter population.--With all the favorable conditions noted heretofore, it would appear that wild turkeys should thrive well in the Missouri Ozarks were it not for the presence of certain widespread limiting factors for which man himself is chiefly responsible. The Ozarks are inhabited not only by an agriculturally inclined resident group but also by a shifting squatter group. In this region, no section, regardless of its isolation, is free from the native instinct of certain of these hill people to live off the land and to kill game at will as an inviolable heritage and personal right.

Usually one or more individuals or families in each community are responsible for the human predations on the turkey range within a day's foot or horseback travel. The rural population, together with a population of the same character in numerous small scattered communities, averages 10 persons per section in direct contact with the range, which far exceeds the average turkey population over the same range.

To enter this domain of the ancestral hunter, who has always lived off the game resources of the country, and effect conservation measures involves the slow process of public education. One can readily visualize the difficulties encountered in the enforcement of game laws, which are generally held in contempt over a section in which the doctrine of personal liberty is virtually supreme.

Startling extent of illegal kill.--The season of winter snows, the gobbling season of spring, the brooding season of midsummer, the deer season of fall, and any fortuitous opportunity during the daily wanderings of man with gun or club take a far heavier toll of wild turkeys over a large part of the Ozarks than the legal December open season. The illegal kill by

man is the greatest factor limiting the turkey population in Missouri.

The midsummer illegal kill, during the first 90 days of the new broods' life, is the worst. On one research area comprising seven townships, whole flocks of turkeys were wiped out and more than 50 percent of other flocks were killed, all within the 31 days of August 1936.

On this area, nine hens produced 99 poults that lived to more than 12 weeks of age. Three hens (33 1/3 percent of the brood stock) and 61 poults (62 percent of the offspring) were killed during the first 90 days of the summer growing season.

In the face of such mortality there is little hope of stabilizing the turkey population, not to mention effecting an increase, by any wild turkey management practices that can be applied.

Considering the number of birds that manage to survive to a huntable age and the vigor evidenced by those that live through the winter season, it is evident that the Missouri Ozark turkey range contains the fundamental requisites for wild turkeys and that under adequate protection alone they would respond with favorable increases.

Under the careful surveillance of this investigation, wild turkeys are reported to be slowly increasing in two southwestern Missouri counties. Flocks have extended their ranges and established small breeding stocks, even in face of heavy legal open-season hunting. Wherever the will of the people has spoken in favor of turkey protection as provided by law, even reasonably small populations of wild turkeys are reported holding their own in proximity to a rather dense human population, and in some cases they even appear to be increasing.

Fires.--The 1936 Ozark spring burning season was an outstanding example of possible range devastation by fire following extended drought. On less than 2,000,000 acres of national forest land on which fire-prevention and protection work has been carried on intensively for two years, more than 1,200 fires, burning from 10 to more than 3,500 acres each, occurred between January and June, reaching a peak of some 400 fires during the 10-day period at the beginning of the wild turkey nesting season (pl. 2). Eliminating the fire protection now given, one can visualize the almost total burns of years past. The destruction of turkeys is shown by burned nests and eggs.

Some offsetting benefits from burning.--Little justification can be found for the native Ozarkan's mania to "burn off the woods" in the spring and fall. The original purpose was improvement of grazing conditions by bringing up earlier green forage in spring and removal of a suppressing leaf blanket in fall. These firings are augmented by innumerable touch-offs "just to see 'er burn".

Light burning late in March apparently does accelerate early growth, producing a sparse green herbaceous cover about ten days later. Cattle and turkeys as well are attracted by these early green shoots, and the residents are deluded into thinking that continuation of such burning is beneficial.

Repeated burning and uncontrolled wildfire on the upper slopes of the turkey range, much of which exceeds a 20 percent slope, has resulted in bringing succession to a standstill and in causing progressive depletion of ground cover, the end result of which brings bare rock and continuous beds of cherty stone to the surface by erosion of the top soil.

On the steep slopes and thin soils of the Ozark region as a whole, controlled burning for beneficial results should be practiced only once in five or more years. Natural burns of such periodicity and intensity apparently have no adverse effects upon succession or maintenance of desirable soil conditions.

Burning produces variable results at different seasons. Midsummer and fall burns are the most destructive, as they retard forest succession or cause a reversion to earlier stages and produce defective timber stands. Spring burns tend to retard forest succession and either hold herbaceous succession at a standstill or revert the succession by producing barren open areas where pioneer plants must repeat an herbaceous sequence.

This continued burning program, however, has been responsible for the maintenance of a semi-open condition of forest ground cover that is highly suitable for wild turkey use, even though at the expense of good forest management and preservation of surface soil. Though conducted at wrong seasons of the year, such burnings have encouraged heavier stands of herbaceous wild turkey food and cover plants, particularly the legumes. The creation of open areas by burns and the resultant effect upon the soil have brought increased stands of lespedezas, trefoils, wild beans and peas, and great beds of Tephrosia, huckleberry, and sumach, with a subsequent invasion of the panic grasses. The little immediate value of burns in producing usable stands of grass is indicated by the fact that they are followed also by increased stands of acid-soil-indicator grasses, such as Danthonia.

That these pioneer and desirable herbaceous successions follow openings produced by any means indicates that openings are the requirement for such growth. As forest succession, either natural or managed, produces more shade, a denser ground litter of dead material, and more soil, the herbaceous ground cover becomes increasingly diminished, and is accompanied by the elimination of sedges and desirable grasses as density factors, a great reduction in legumes, and a limitation of the other typical open-area plants.

Restoration of such cover will require management directed toward the production and maintenance of a proper balance of open areas. The present alternatives appear to be either managed cutting or controlled burning. A combination appears to be the most practical and efficient.

The fire program of the Forest Service, affecting 3,319,939 acres in the heart of the Ozark turkey range, has resulted in the construction and planning of roads that will leave no township in that area free from the presence of road gangs and a permanent development of accessibility, and this will eliminate the wilderness area of township-size units. Limited land and road development is not in itself considered a factor inimical to turkey range, but extensive development practices, as they affect range use in this

critical period for any effective turkey restoration program, and their significance to turkey management in the future, are hardly consonant with efforts to preserve isolated turkey ranges.

Free-range grazing.--Most of the Ozark turkey range is subject to free-range stock law, jealously preserved as a heritage of the people. It results in serious overgrazing by great numbers of livestock, including sheep, goats, cattle, horses, and hogs. A State local-option law permits the residents of any county to decide whether their county shall be open or closed range. To change this status of the range requires an election, obtainable only by a petition of the legally qualified voters.

A grazing analysis of the 15 counties in the Clark National Forest of southeastern Missouri (entirely open range) showed a total of 131,000 head of stock, including cattle, hogs, sheep, and goats, in January 1936. Such analysis indicates that this range should support 39,985 head, disclosing more than 300 percent overgrazing.

The typical upland areas of wild land, outside of any improved grazing range (which constitute the lands being purchased by the Government for national forest purposes), demonstrate an average estimated carrying capacity of 40 to 50 acres per head of cattle. Depleted by fire, soil erosion, and misuse, much of this area has been estimated to have a carrying capacity of 100 or more acres per head of cattle. Being overgrazed as shown, there is a natural and inevitable concentration of unusually large numbers of cattle on the more desirable sections of the range.

Effect of stock on the wild turkey.--As it affects the wild turkey, the greatest damage done by concentrated grazing lies in the disturbance and limitation of the natural growth and abundance of ground food and cover plants used by the turkey, and in the undesirable use by cattle of available water sources. Cattle are an important factor in the early drying up of the small ridge-top water sources, shown to be so desirable for turkey range. Cattle distribution in this Ozark upland during midsummer months centers around permanent water. Grazing at that period is observed to be limited to the bottoms supporting a growth of the more palatable grazing plants and increases with their proximity to water sources. Cattle congregate around these water sources most of the day, reducing and sometimes eliminating sources of free-flowing water and surrounding ground cover until native wild turkeys will not make use of it. Native turkeys, especially hens with broods, show a definite tendency to avoid cattle. Cattle grazing in such areas practically eliminates the herbaceous food and cover used by the wild turkey.

The effect of grazing on the upper slopes and ridge tops, however, may be less serious. Highly prized turkey food and cover plants are found on the slopes untouched and immediately adjacent to drainage bottoms that have been grazed into a bed of dust. Apparently the leguminous plants sought by the turkey in such situations are little grazed by cattle.

Cattle grazing is believed to be most detrimental to turkey range, however, not only by reason of its mechanical effect and its mere presence as a disturbing factor, but also by its reduction of the water supply and its tendency to disturb normal use by the birds of water sources.

Effect of human activity on turkey range.--Native wild turkeys on natural range show a decided tendency to avoid areas in regular use by man. Through extensive agricultural development following early logging days, this factor alone pushed isolated parts of the turkey range back into a limited area. Abandonment of much of this farmed land in recent years probably benefits the turkey by providing open fields close to timbered areas, a type of range much used by the birds in feeding.

Loss of wilderness areas through road building.--Twenty years ago, most of the Missouri Ozark region was accessible only by a poor system of county roads and remnants of old logging trails. Today a highly developed system of primary State roads and secondary county roads makes virtually every large area of backwoods country easily accessible and subject to increased human occupation. Recent years also have brought a renewed impetus to the lumbering industry that is exploiting the remaining timber resources, until practically every community in southeastern Missouri has its river mat mill, stave mill, header mill, or lumber mill, industries that bring timber workers into most of the region. The mere presence of these timber crews has affected the natural use of the range by wild turkeys and brought about an increased illegal kill.

Hunters and recreational development.--Better roads have brought more turkey hunters into the woods, both in and out of season. Ten years ago, the State of Missouri owned more than 50,000 acres of isolated wilderness area, suitable for wild turkey range and so used. Today, with these areas developed for recreational purposes and intensive management by aid of the Emergency Conservation Works program, it is questionable whether they will longer be used by the turkey. These factors of increased human occupation do not fit in with the observed tendency of the turkey to select its natural range in areas free from interference.

FIELD MANAGEMENT

Providing Food Patches

Deficiency in winter green food.--The Ozark turkey range is notably deficient in succulent green food during the critical midwinter period and the early spring months. This may be changed, where intensive field management is practiced, by suitable plantings. Food patches, serving for range improvement, are important to birds liberated as stock on free range and in localizing both native and restocked birds. Winter wheat is suitable to either intensive or limited management for winter and spring green food.

Suggested plantings.--Planting of food patches in strips 1 chain wid and 10 chains long adjacent to low cover is considered ideal for use by wild birds. Wheat may be successfully grown, for limited management, in open woods by clearing the ground cover and scarifying the surface with hand tools before broadcasting the seed. Wild birds seem to like this type of planting and will take full advantage of the crop. At the borders of old fields or open areas better growth and a more dense stand will reward cultivation, or heavier planting following plowing.

Cultivated grains successful.--Several cultivated species of grain have been tried in Ozark food patches with some success. Corn requires much work and is hardly worth the effort on the poor Ozark soil available. Most of the sorghums mildew in the wet winter seasons. One variety of sorghum, called fodder cane and grown in a single community of southwestern Missouri for the seed market, comes up something like broom corn with a dense growth of leaves at the base and a single seed stem bearing an exceedingly loose raceme head with a heavy crop of small oval seed. The seed stem breaks over with frost, but, when the stand is planted broadcast, it does not reach the ground and hangs above it throughout the winter. Foraging turkeys are completely hidden by the basal leaves but have the grain within easy reach. Two hundred birds were accommodated to a range by holding them on a two-acre patch of this feed for three months without other feed.

Soy beans and cowpeas make a good feed patch, the birds apparently preferring the beans. A variety of soy bean, called "Arksaw" and developed at the Arkansas Agricultural College, has been successful, as it produces a high bush carrying a heavy seed crop in long pods, which do not break open at the ripening period but hold firmly on the plant throughout the winter.

Proso, million-dollar grass (Japanese barnyard millet), and other millets are readily taken by turkeys and will be eaten until the heads of all plants have been stripped or consumed entirely. Winter rye may be planted in suitable places for spring green food.

Chufa, planted during the 1936 drought season, failed to make a stand, while million-dollar grass, planted at the same time, proved to be highly drought resistant.

Fencing of patches essential.--Ozark free-range conditions make it imperative that all feed patches be enclosed against destruction by cattle and hogs. Wire fences somewhat destroy their value, as turkeys do not readily cross a wire fence. For this reason rail or pole fences are more practical.

Restocking

Early failures; selection of birds; liberation methods.--The rapid decline in turkey populations has resulted in active programs of conservation through restocking. First efforts consisted of liberating a small number of domestic turkeys within State parks, in hope of producing a satisfactory artificial hunting resource. Unfortunately, this was based upon the farmyard experience of having occasional groups of birds go wild. The immediate failure of these liberations brought on a search for the best available wild turkey stock for the purpose.

For five years, private breeders imported artificially propagated brood stock from sources throughout the United States, principally Virginia and New York. Several generations of selective breeding materially improved upon the original imported stock, and great improvement is shown in the Missouri-produced bird of today. In 1931, the Missouri Game and Fish Department established four wild turkey production units on State parks within the turkey range, which were operated for three years, reaching a maximum

annual output of more than 3,000 birds. Then, for one year, all this stock was centralized on one State park, where a single production unit was operated on an experimental basis. For the past three years, birds for restocking purposes have been purchased entirely from private breeders.

The numbers of birds involved in restocking liberations in Missouri during the eleven-year period 1925-35, taken from such official records as were available to the investigation, were as follows (asterisk indicates incomplete records):

1925	350
1926*.....	?
1927	250
1928	695
1929*.....	12
1930	352
1931*.....	?
1932	1,525
1933	4,395
1934*.....	863
1935*.....	785
Total.....	9,227

Of the 863 birds recorded above for the 1934 period, 464 were liberated on the Missouri National Forest purchase units. The 1935 figure represents only birds liberated on the national forests.

Methods of producing artificially propagated wild birds.--During the last five years, the artificially propagated wild turkey in Missouri has been vastly improved, and today the stock represents one of the finest wild-type birds available in the country. The system of management is designed to breed into the stock the best wild characteristics of the native birds remaining on the Ozark range. The principal wild turkey breeding unit in the State has a brood stock of 150 to 200 hens, with an annual production of from 2,000 to 3,000 birds.

Use of native wild gobblers.--No confined gobblers are utilized. Breeding pens of two to four acres each are scattered through the most isolated parts of the native wild turkey range where native gobblers are available. The pens are made with 5-foot field fencing, or rabbit wire, and contain a pole roost, completely enclosed by poultry netting to protect the brood-stock hens at night.

Construction of breeding pens.--No wild turkey, in fact no turkey, seems to cross a wire fence readily. It will pace a beaten path along the fence, mechanically sticking its head through every part of the wire but making no effort to cross over. Where ordinary low field fencing is used, crossing may be induced by leaning poles against each post, at a gradual incline, in the direction of the desired crossing.

This procedure has been improved in the recent use of higher wire fences by constructing an ordinary rail fence immediately against the wire fence on the side of crossing. This prevents the approaching bird from

getting up to the wire near the ground, limits its visibility through the fence, and encourages it to fly onto the rail fence, whence it will readily hop or fly over the few feet remaining of higher fence. The two fences must be in direct contact, however, or the bird will get down between them and the purpose of the rail fence will be defeated.

Visiting gobblers.--About 20 or 30 selected turkey hens are placed in each pen 30 to 60 days before the laying season. Gobblers over a wide area about the pens soon become aware of their presence and, if proper isolation is maintained, will frequent the pens regularly throughout the breeding season. Remarkably enough, considering the scarcity of native wild turkeys on most of the Ozark range, wild gobblers have been attracted to breeding pens of hens in protected parts of any section of the turkey range.

Enough wild gobblers will visit the pens regularly for keepers in charge (day and night) to select their breeding gobblers for trophy-type quality by keeping out any that do not meet their critical inspection. Observations by these pen keepers further emphasize the degree of variation that may be found in the native wild bird on free range.

Laying habits of hens in isolated pens.--Hens held under such confinement do not nest in the usual manner. Several may lay in the same nest, or eggs may be deposited on the ground at random, very much as do confined pheasants. Such hens may produce 50 or more eggs for a flock average, but undesirability of late hatches ends the managed laying season about June 1.

Handling and incubation of eggs.--Eggs are collected by pen keepers, daily or more often. All are carefully marked, to facilitate hatching and management records, and are held one week to ten days in a uniformly cool, moist, well-ventilated, darkened place before removal to the hatchery. The eggs are hatched by electric, force-draft incubators and the poults removed to a brooding farm the second day.

Brooder construction and methods.--Features of the specially designed brooder houses include provision for adequate floor ventilation without floor drafts, adequate overhead ventilation to maintain a constant floor temperature and reduce the atmospheric temperature on hot days, thermostatically controlled oil-brooder stoves, maximum degree of light, a wire-bottom porch equal to or larger than the brooder-house unit, and other minor facilities.

Poults are started in groups of 200 to 400, depending entirely upon the size of the brooder unit and the facilities to prevent overcrowding. Under the present system, birds are kept off the ground and raised on commercial mash feed for at least six (sometimes eight) weeks before they are transferred to range pens on the ground. They are held in small pens until 10 to 14 weeks, at which time they are now being distributed to restocking management areas and liberated on free range, or under semiconfinement in large range pens.

Liberations

Practical size for flock.--Liberation of more than 12,000 artificially propagated wild turkeys in Missouri during the last ten years has demonstrated

many possibilities in restocking, and probably more about inefficient practices. Birds have been liberated in flocks of all sizes from 5 to 200, in varying sex ratios, and in many different habitats. The large flocks have proved most unsatisfactory because the birds immediately begin to break up and range away from the point of liberation in groups of 12 to 16. The present practice of liberating 15 birds in a group on free range is apparently the most practical.

Best ages for survival.--Birds also have been liberated at all ages, from eight weeks to one year. Those of advanced ages show less adaptability to natural wild living conditions and fail to demonstrate as desirable reactions as wild birds because of their earlier extended confinement and artificial management. Results from late liberations have been poor, because most of the birds did not survive long enough to acquire wild habits, and management toward making them wild was ineffectual.

Liberations to develop wildness.--To make turkeys go wild, observers have found it best to liberate them at the earliest age they can survive under natural conditions. Birds less than 10 weeks old, raised under purely artificial conditions, do not adapt themselves readily to open range, and therefore they suffer excessive mortality from many causes. From 14 to 18 weeks appears to be the best period for liberation, dependent upon the environment and management program under which the birds have been raised.

Select stock, especially from early hatches of quality birds now being produced in Missouri, apparently sustain themselves, learn to forage for natural foods, and readily develop the roosting and ranging habits essential to their survival. The chief difficulty encountered is a tendency of newly liberated turkeys to drift downgrade in the drainages to agricultural lands and homesteads in the drainage bottoms, where they will take up residence, if permitted. Reactions have been better among flocks liberated at points remote from human habitation. Restocked birds, liberated in the midst of a much-used native wild turkey range, are assisted by the native birds to develop habits of flocking along with the native wild groups.

Stockings frustrated by illegal hunting.--Such a high percentage of free-range liberations has been wiped out by illegal killing that much study of results has been completely frustrated. About the only definite conclusion obtained is that at the present time any liberation involving the limitations of artificially propagated stock on typical unprotected free range in the Missouri Ozarks is doomed to failure. The limited success thus far recorded has been largely due to strict protection on areas where management patrol is maintained. This has been augmented by study in a few communities where localized public sentiment in favor of protection, unusual freedom from illegal killing, or absence of extensive hunting during the legal open season, have permitted a survival that can be observed and measured.

Large-pen method and its accomplishment.--The two major problems confronting the Missouri restocking program are: (1) holding liberated birds in a desirable habitat; and (2) protecting them over a period adequate to accomplish transition into the typical wild state. Careful study of management practices has developed a procedure that brings about a natural solution of

the first problem.

Birds delivered to the Forest Service during the last year have been held in groups of 35 to 50 hens in 40- to 80-acre penned enclosures, sufficient gobblers being held to assure fertility, a practical ratio being one gobbler to ten hens. After the initial period of accommodation to feeding range, if the pens are properly placed, the birds will support themselves without artificial feeding, except during severe winter spells of ice or snow. The hens then breed and lay at will within the large pen, where they are kept under regular patrol. When the hatch comes off the next spring, the broods are kept under observation and will remain in the pen for four to six weeks without difficulty. They are then permitted to leave, each hen leading off her brood into any range she may select.

Range covered by liberated flocks.--Most of these broods will take up a new range within an average radius of 2 to 3 miles from the point of production. A high percentage select ranges away from human habitation and, within 60 to 90 days, will take on such wild characteristics that the entire brood will flush in escape flight at considerable distance from an approaching observer.

The success of this practice would commend this unit system of production and hen-and-brood accommodation to range for repopulating an area, the maximum extent of which approaches the township unit.

Maximum accomplishment--the ultimate goal of any restocking program--makes protection of such stock an absolute necessity. Establishment of refuge areas within their range seems to be the only possible means of providing this protection in Missouri.

Range movements of native wild and restocked birds are surprisingly similar, and for various range uses have an average radius of about three miles. This applies when the birds have been liberated in a carefully selected area that provides all the normal requisites of a wild turkey range.

When the area has been deficient in these requisites, flocks have been known to drift 25 miles. More than average movements may be encouraged by a tendency of young birds to wander. Acquaintance with these facts is of major importance to a refuge program directed toward provision of continuous protection for birds liberated as brood stock.

FUTURE CONSERVATION PROBLEMS

The major problems that will confront turkey conservationists in Missouri for some years to come are involved in the establishment of a uniform population that will maintain itself. Any system of protection that does not cover the bird's normal range will frustrate its own accomplishment. It is now indicated that the adequate-sized turkey management refuge unit approaches the area of a township, whether it be applied to artificial restocking or management of native wild birds for natural reproduction.

The life history and management investigation has sought thus far a well-rounded picture of actual conditions as they affect the wild turkey and

the restoration activities already undertaken in and immediately adjacent to the national forests. Despite the multiplicity of problems encountered, some of the most fundamental needs are quickly apparent.

The remaining native population of wild turkeys, their present distribution, the survival of reproduction, and the vigor of the birds found on the range at all seasons, all indicate that the Missouri Ozarks provide the fundamental requisites of wild turkey range and the essentials to the maintenance of a substantial turkey population over a large part of the national forests in the State. The natural sources of loss there and the limitations on abundance due to predators and competition with other species are not overly severe, and grazing does not appear to be an insurmountable limitation to present populations. Wildfire is far more serious and as a limiting factor is surpassed only by illegal hunting.

The sole limiting factor responsible, at this time, for holding an absolute check on any increase of the species over the forests as a whole is the excessive kill by man. The legal kill during the 30-day open season provided by Missouri law is insignificant when compared with the number of turkeys killed illegally. From all available evidence, the annual legal kill would not be an important limiting factor, though in some areas more birds are killed than are produced, and under such conditions, eventual extermination is a mere matter of elementary mathematics.

Preservation of the wild turkey on such areas will require immediate action to provide protection for the remnant of the brood stock that still exists. Improvement of local conditions will necessitate a well-planned and aggressive program of public education to bring about constructive conservation thinking and law observance. Law enforcement will require a definite system of forest patrols and close cooperation in game-protection on the part of all administrative agencies responsible.

Establishment of refuges probably will be the most practical approach to a solution of the region-wide illegal kill and will serve best to protect breeding areas throughout the year. The most practical and effective refuges established for these purposes should be as large as possible, minimum size being one township, or a tract 6 miles square. Since the most desirable management is that applied to the native wild bird, the location of refuges established for that purpose must be determined according to the present turkey population and the range used.

Restocking with artificially propagated wild turkeys in the past has been generally unsuccessful because of the same factor of kill, legal and illegal, that has been responsible for depletion of the native wild populations. Holding restocking turkeys over the first year as brood stock on a unit management system has proved satisfactory in getting a desirable bird into the wild and establishing breeding flocks.

Continuation of the restocking program should be directed to continued improvement of the mass wild turkey population by liberation of birds of a quality that will equal the physical and breeding characteristics of the native trophy-type wild specimen.

If conditions favorable to the maintenance of the turkey are to be provided, forest management over a long period of years will be confronted with the problem of providing means not only to rejuvenate the forests but also to preserve open areas suitable for wild turkey range.

TABLE 1.--Vegetable food of the wild turkey in the Missouri Ozark range, as determined by field observation and stomach examination

[Explanation of symbols: (A), Determination by stomach analysis; asterisks (* or **), foods preferred or greatly preferred; abbreviations for seasonal use--Sp, spring; S, summer; F, fall; W, winter; blanks in third column indicate that any part of the plant may be eaten without preference.]

Family and species		Parts eaten	Season used
Common name	Scientific name		
FERN FAMILY	POLYPODIACEAE		
Christmas fern	Polystichum acrostichoides	Leaves	S-F
GRASS FAMILY	GRAMINEAE		
Bluegrass (A)	Poa sp.	Fruit	W
Lovegrass	Eragrostis spectabilis		S
Satingrass	Muhlenbergia sylvatica		S
Dropseed (A)	Sporobolus asper	Fruit	W
Panicum	Panicum perlongum		S-F
Do	P. linearifolium	Fruit	S-F
Do	P. dichotomum		S-F
*Do	P. barbulatum	Leaves	S-F
Do	P. huachucae var. fasciculatum		
Do	P. lindheimeri	Fruit	S-F
Do	P. boscii		S-F
Fall panicum	P. dichotomiflorum	Fruit	W
Panicum	P. flexile	Leaves	S-F
Do. (A)	Panicum sp.	Fruit	W
Green bristlegrass	Setaria viridis		S-F
Prairie beardgrass	Andropogon scoparius	Young leaves.	S-F
Indian grass	Sorghastrum nutans	Fruit	W

NOTE: The scientific names in this table (except for grasses) are, because of the local character of the study, based on Palmer and Steyermark's "Annotated Catalogue of the Flowering Plants of Missouri" (Ann. Missouri Bot. Garden 22 (3): 375-758, illus., Sept. 1935). Hitchcock's "Manual of the Grasses of the United States" has been followed for the scientific names of grasses. Common names are taken from standard sources, including Standardized Plant Names, where applicable.

TABLE 1.--Vegetable food of the wild turkey in the Missouri Ozark range--Cont'd

Family and species		Parts eaten	Season used
Common name	Scientific name		
SEDGE FAMILY	CYPERACEAE		
Slender spikerush	Eleocharis acicularis	Young spikes	Sp
**Sedge	Carex cephalophora	Fruit	S-F
Do	C. glaucodea	.....	.....
Sedge (A)	Carex spp	Fruit	W
LILY FAMILY	LILIACEAE		
False solomonseal	Smilacina racemosa	.....	S-F
Bristly greenbrier	Smilax hispida	Leaves	S-F
BIRCH FAMILY	BETULACEAE		
*Hophornbeam (A)	Ostrya virginiana	Fruit	W
BEECH FAMILY	FAGACEAE		
White oak	Quercus alba	Acorns	F-W
*Post Oak (A)	Q. stellata	..do	F-W
Willow oak	Q. phellos	..do	F-W-Sp
**Blackjack oak (A)	Q. marilandica	..do	F-W-Sp
NETTLE FAMILY	URTICACEAE		
*Hackberry	Celtis occidentalis var. canina	Fruit	F-W
*Hackberry	C. laevigata var. texana	..do	W
BUCKWHEAT FAMILY	POLYGONACEAE		
Dotted smartweed (A)	Polygonum punctatum	.....	S-F-W
Climbing false buckwheat	P. scandens	.....	S-F
POKEWEED FAMILY	PHYTOLACCACEAE		
Pokeberry	Phytolacca americana	Leaves, berries	S-F
LAUREL FAMILY	LAURACEAE		
Sassafras	Sassafras officinale var. albidum	Young leaves	S-F
SAXIFRAGE FAMILY	SAXIFRAGACEAE		
Smooth hydrangea	Hydrangea arborescens	Leaves	S-F
ROSE FAMILY	ROSACEAE		
*Wild strawberry	Fragaria virginiana var. illinoensis	Fruit	S
**Wild rose (A)	Rosa sp	..do	F-W
LEGUME FAMILY	LEGUMINOSAE		
Sensitive brier	Schrankia uncinata	Leaves	S-F
Partridge-pea (A)	Cassia nictitans	Fruit	W
Purple prairieclover	Petalostemum purpureum	.....	S-F
White prairieclover	P. candidum	.....	S-F
Hoary-pea	Tephrosia virginiana	Fruit	F-W
**Tick clover	Desmodium rotundifolium	Flowers, fruit	S-F
Do	D. canescens	..do	S-F-W
Do	D. dillenii	.....	S-F
Do	D. paniculatum	.....	S-F
Do	D. sessilifolium	.....	S-F
Do	D. marilandicum	.....	S-F
Do. (A)	Desmodium sp	.....	S-F-W

TABLE 1.--Vegetable food of the wild turkey in the Missouri Ozark range--Cont'd

Family and species		Parts eaten	Season used
Common name	Scientific name		
LEGUME FAMILY--Cont'd	LEGUMINOSAE		
**Lespedeza (A).....	Lespedeza procumbens.....	Leaves.....	S-F
**Do.....	L. repens.....	..do.....	S-F
**Do.....	L. virginica.....	Flowers, fruit	S-F
**Do.....	L. intermedia.....	.....	S-F
**Do.....	L. hirta.....	Leaves.....	S-F
**Do.....	L. capitata.....	..do.....	S-F
**Do.....	L. striata.....	.....	S-F
**Do. (A).....	L. stipulacea.....	Fruit.....	W
Wild bean.....	Strophostyles umbellata.....	.....	S-F
Milk-pea (A).....	Galactia volubilis var. mississippiensis.	.....	S-F
SPURGE FAMILY	EUPHORBIACEAE		
*Croton.....	Croton capitatus.....	Fruit.....	S-F
*Croton.....	C. monanthogynus.....	..do.....	S-F
Spurge.....	Euphorbia nutans.....	Leaves, buds..	S-F
**Flowering spurge....	E. corollata.....	Flowers, leaves fruit	S-F
Spurge.....	E. dentata.....	..do.....	S-F
CASHEW FAMILY	ANACARDIACEAE		
*Smooth sumach (A)...	Rhus glabra.....	Fruit.....	F-W-Sp
*Fragrant sumach.....	R. canadensis.....	..do.....	F-W-Sp
BUCKTHORN FAMILY	RHAMNACEAE		
Jersey-tea (A).....	Ceanothus americanus.....	..do.....	W
VINE FAMILY	VITACEAE		
Virginia creeper....	Parthenocissus quinquefolia.....	Young tendrils	S-F
**Summer grape.....	Vitis aestivalis.....	Young tendrils fruit	S-F
**Frost grape.....	V. cordifolia.....	Leaves, fruit.	S-F-W
Wild grapes (A).....	Vitis spp.....	Fruit.....	W
PASSIONFLOWER FAMILY	PASSIFLORACEAE		
Passionflower.....	Passiflora lutea.....	Tendrils.....	S-F
DOGWOOD FAMILY	CORNACEAE		
*Flowering dogwood(A)	Cornus florida.....	Fruit.....	F-W-Sp
Roundleaf.....	C. asperifolia.....	..do.....	F-W-Sp
**Blackgum.....	Nyssa sylvatica.....	..do.....	F-W
HEATH FAMILY	ERICACEAE		
*Dryland blueberry...	Vaccinium vacillans var. crinitum...	Leaves, fruit	S
EBONY FAMILY	EBENACEAE		
Persimmon.....	Diospyros virginiana.....	Leaves.....	S-F
MILKWEED FAMILY	ASCLEPIADACEAE		
Whorled milkweed....	Asclepias verticillata.....	.....	S-F
POLEMONIUM FAMILY	POLEMONIACEAE		
Phlox.....	Phlox pilosa var. virens.....	.....	S-F

TABLE 1.--Vegetable food of the wild turkey in the Missouri Ozark range--Cont'd

Family and species		Parts eaten	Season used
Common name	Scientific name		
MINT FAMILY	LABIATAE		
Selfheal	Prunella vulgaris		S-F
Sage	Salvia lyrata		S-F
Pennyroyal	Hedeoma pulegioides		S-F
NIGHTSHADE FAMILY	SOLANACEAE		
Horsenettle	Solanum carolinense	Leaves	S-F
MADDER FAMILY	RUBIACEAE		
Bedstraw	Galium pilosum	Fruit	S-F
*Do	G. arkansanum	..do	S-F
*Longleaf bluet	Houstonia longifolia	..do	S-F
HONEYSUCKLE FAMILY	CAPRIFOLIACEAE		
Coralberry (A)	Symphoricarpos orbiculatus	..do	W
Elderberry	Sambucus canadensis		S-F
COMPOSITE FAMILY	COMPOSITAE		
Oldfield goldenrod	Solidago nemoralis	Young buds	S-F
Sky-drop aster	Aster patens	Flowers, buds	S-F
Aster	A. anomalus		....
Azure aster	A. azureus	Flowers, fruit	S-F
Everlasting	Gnaphalium obtusifolium	Leaves	S-F
Ragweed (A)	Ambrosia artemisiaefolia var. elatior	Fruit	W
Do. (A)	A. psilostachya	..do	S-F-W
Coreopsis	Coreopsis palmata		S-F
Thistle	Cirsium altissimum	Fruit	S-F
Hawkweed	Hieracium gronovii		S-F

BIBLIOGRAPHY

Audubon, John James.

1840-44. The birds of America; from drawings made in the United States and their territories. 7 vols., illus. New York and Philadelphia.

Bent, Arthur Cleveland.

1932. Life histories of North American gallinaceous birds. Smithsonian Inst., U. S. Natl. Mus. Bull. 162, 490 pp., illus. Washington.

Leopold, Aldo.

1931. Report on a game survey of the North Central States. 299 pp., illus. Madison, Wis.

Stoddard, Herbert Lee.

1935. Wild turkey management. Amer. Game Conf. Trans. 21: 326-333. Washington.

1936. Management of wild turkey. North Amer. Wildlife Conf. Proc. 1936: 352-356. Washington.

Wilson, Alexander; Bonaparte, Charles Lucian; and Jardine, William.

1833. American ornithology; or the natural history of the birds of the United States. 3 vols., illus. London and Edinburgh.